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DEFENSE ACQUISITIONS

Challenges Associated with the Navy's Long-Range Shipbuilding Plan

Statement of Paul L. Francis, Director
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Why GAO Did This Study

The Navy's long-range shipbuilding plan spells out its approach to meeting the Navy's future needs. This plan shows the Navy is embarking on an ambitious, expensive undertaking to develop, design, and construct a number of new ship classes. The Navy expects these vessels to successfully execute missions in a variety of environments through use of advanced technologies, while utilizing reduced crews and greater automation to lower costs. The Navy also expects these vessels to be constructed in quantities that sustain the industrial base and expand the overall size of the Navy. The plan calls for the number of ships to increase by about 10 percent to an average of about 309 ships through 2036. This effort will cost billions of dollars.

At the request of Projection Forces Subcommittee of the House Armed Services Committee, GAO examined the Navy's shipbuilding plan and is providing this discussion of 1) the multiple objectives the plan proposes to meet; 2) the challenges that must be met to execute the plan; and 3) ways the Navy can reduce the tension between the demand for and supply of shipbuilding funds.

www.gao.gov/cgi-bin/getrpt?GAO-06-587T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Paul Francis at (202) 512-4841 or francisp@gao.gov.

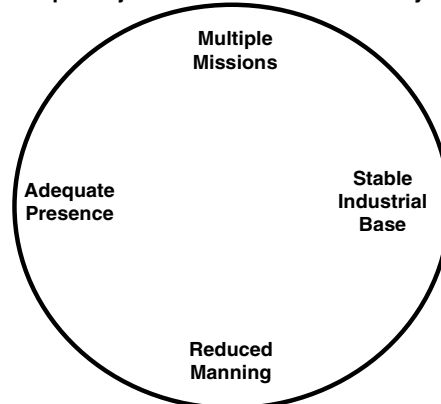
DEFENSE ACQUISITIONS

Challenges Associated with the Navy's Long-Range Shipbuilding Plan

What GAO Found

While the Navy's shipbuilding plan is beneficial in that it lays out a strategic approach for decision making, there is tension inherent among the plan's multiple objectives. For example, demanding mission requirements can result in more costly ships that cannot be built in the numbers desired for presence and shipyard workload. These tensions presage the potential trade-offs that will likely have to be made. The key is to anticipate and make trade-offs early in the context of the overall shipbuilding strategy. If the Navy starts more programs than it can finish within available resources, it may be forced to make trade-offs in the future that it may not find acceptable today.

Multiple Objectives Embodied in the Navy Shipbuilding Plan



GAO (presentation).

Assuming the long-range shipbuilding plan is consistent with national military priorities, the main challenge in execution is keeping the supply and demand for funds in a rational balance that does not overly sacrifice one objective to meet another. The Navy projects a supply of shipbuilding funds that will double by 2011 and stay high. At the same time, increasing demands on the federal budget—including for weapons for other services—suggest such growth in shipbuilding funds may not materialize. The Navy's own ability to control the demand for shipbuilding funds is also a challenge. If the Navy cannot control cost growth on new ships, some other objectives of the plan will have to be sacrificed, such as mission capability or presence.

There are several ways the Navy can help reduce the tension between the demand for and supply of shipbuilding funds. To control unanticipated cost growth on individual programs, it is important that the Navy ensure programs have sufficiently high levels of knowledge before making programmatic, budgetary, or contractual commitments. To maximize the amount of funds the Navy can devote within its budget to shipbuilding, it must continue to find ways to lower total ownership costs by reducing manning requirements and to improve operational availability of ships through means such as rotational crewing.

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss the Navy's long-range shipbuilding plan. The plan lays out the Navy's approach to meeting its future needs. If followed literally, the plan will be an expensive undertaking that will require billions in new ship construction funding. The feasibility of the plan depends on a number of factors, including increasing the supply of shipbuilding funds while controlling the demand for funds by individual programs.

Today I would like to discuss (1) the multiple objectives that the Navy's long-range shipbuilding plan proposes to meet, (2) the challenges that must be met to execute the plan, and (3) ways that the Navy can reduce the tension between the demand and supply for shipbuilding funds. Before discussing these issues, I want to recognize the value of the Navy's having prepared the plan as requested by Congress. I look at it as a vehicle for discussing and debating strategic shipbuilding issues before embarking on individual programs. This course is much preferable to pursuing individual programs without a strategic direction in mind. Thus, the shipbuilding plan is not something that should be used to polarize hardened positions, but rather to permit an intelligent discussion that will make for better decisions in the future.

Summary

The Navy is embarking on an ambitious undertaking to develop, design, and construct a number of new ship classes to support operations on, under, and beyond the world's oceans. The Navy expects these vessels to successfully execute missions in a variety of environments through use of advanced technologies, while utilizing reduced crews and greater automation to lower costs. The Navy also expects these vessels to be constructed in quantities that sustain the industrial base and increase the number of Navy ships. There is tension inherent among the multiple objectives of the plan. For example, demanding mission requirements can result in more costly ships that cannot be built in the numbers desired for presence and shipyard workload. Requirements to reduce manning can actually demand more automation and sophistication, which can translate into higher acquisition cost. These tensions presage the potential trade-offs that will likely have to be made. The key is to anticipate and make trade-offs early in the context of the overall shipbuilding strategy. If the Navy starts more programs than it can finish within available resources, it may be forced to make trade-offs in the future that it would not find acceptable today.

Assuming the long-range shipbuilding plan is consistent with national military priorities, the main challenge in execution is keeping the supply and demand for funds in a rational balance that does not overly sacrifice one objective to meet another. The Navy plan requires more funds than may reasonably be expected. Specifically the plan projects a supply of shipbuilding funds that will double by 2011 and will stay at high levels for years to follow. At the same time, increasing demands stemming from other federal programs, ongoing military operations, and acquisitions by the other services suggest such growth in shipbuilding funds may not materialize. The Navy's own ability to control the demand for shipbuilding funds is also a challenge. Cost growth has been particularly high for first-in-class ships—on the order of 27 percent. The shipbuilding plan calls for more than double the number of new ship classes to start construction in the next 10 years, as compared with the last 10 years. If the Navy cannot control cost growth on these new ships, some other objectives of the plan will have to be sacrificed, such as mission capability or numbers of ships, which could impact presence and overall warfighting capabilities.

There are several ways the Navy can help reduce the tension between the demand and supply of shipbuilding funds. To control unanticipated cost growth on individual programs, it is important that the Navy ensure programs have sufficiently high levels of knowledge before making programmatic, budgetary, or contractual commitments. Good practices along these lines include attaining requirements stability, technology maturity, and design stability early in programs; gaining actual experience with design before budgeting and contracting for construction; contracting for the construction of the lead ship separately from the construction of follow-on ships; and making better use of tools such as cost performance reports. To maximize the amount of funds the Navy can devote within its budget to shipbuilding, it must continue to find ways to lower total ownership costs by reducing manning requirements and to improve operational availability of ships through means such as rotational crewing.

Shipbuilding Plan Proposes to Meet Multiple Objectives

The Chief of Naval Operations recently released a long-range plan for shipbuilding¹ that encapsulates the Navy's vision of the future naval force structure. This is an ambitious plan that proposes to meet multiple objectives, including

¹ *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007.*

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- building ships that support new missions,
 - building more sophisticated ships to support existing missions,
 - building workhorse ships like tugboats,
 - increasing numbers of ships to improve presence and ability to carry out missions,
 - designing ships and operating concepts to reduce manning requirements, and
 - devising construction workloads to stabilize the industrial base.

The plan would boost the number of ships in the Navy's inventory from today's level of 281 to an average of about 309 ships through 2036—a 10 percent increase.² The plan includes developing and constructing a number of new ship classes to support the way the service would like to operate in the future. New ships are proposed for nearly every class, from improved aircraft carriers and submarines to new types of surface combatants. The DD(X) destroyer is to provide strike and volume fires with increased range and lethality. Seabasing is to be facilitated by large deck, expeditionary warfare ships and connectors, by future maritime prepositioning forces, and by a new generation of combat logistics forces. Littoral combat ships are to provide defenses against submarine, mine, and surface threats. Theater ballistic missile defense technologies are to be employed on guided missile destroyers and cruisers.

Many of these ships are expected to perform their missions with reduced crew sizes that are to be achieved through increased automation. The Navy also plans to change the way it deploys and structures its fleet around the world by shifting to a greater presence in the Pacific and employing rotational crewing strategies. The fleet is expected to have the capacity to overmatch the nation's most capable adversaries, in all waters, blue, green and brown.

In addition, the Navy's shipbuilding plan seeks to stabilize the industrial base by providing predictable workloads for the shipyards. The Navy has previously reported that a stable shipbuilding industry is essential to meet requirements for an affordable and capable force structure. Cost growth in any given shipbuilding program could result in a fluctuation in the number of ships procured, leading to less work in a particular yard and even cost growth in other shipbuilding programs. We have reported, for example,

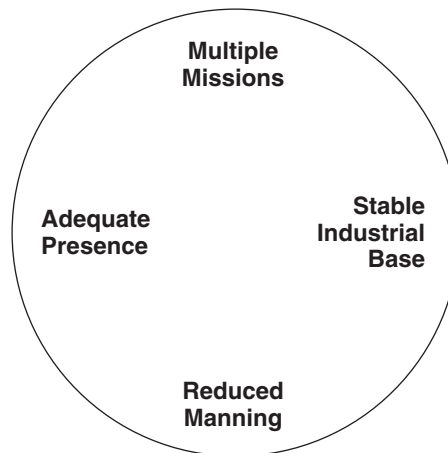
² According to the Navy's plan the naval ship inventory would increase to 315 by 2012, peak at 330 in 2019, and decline slowly to 296 by 2036.

that overhead costs for the DDG 91 and DDG 92, two ships in the current class of destroyers, increased as a result of the delay in signing the contract for the DD(X). Similarly, the pace of the DD(X) detail design and construction schedule has been dictated in part by the desire to avoid work gaps in shipyards.

Laying out such a plan now is constructive because it can be seen as the first stages of an investment strategy or portfolio for new ship acquisitions. Without a plan to guide program choices, there is a risk that individual programs will dictate the plan. A long-term plan, to the extent that it is consistent with national military priorities and is rationalized by reasonable resource expectations, can enable trade-offs to be seen and addressed in advance, leading to better informed choices now. Such a plan makes debate possible before irreversible commitments are made.

There is an inherent tension among the multiple objectives of the plan, which presage the potential trade-offs that will likely have to be made. These are depicted in simple form in figure 1.

Figure 1: Multiple Objectives Embodied in the Navy Shipbuilding Plan



Source: GAO.

The tensions between objectives can play out in several ways. If, for example, a class of ship is expected to perform multiple challenging missions, it will have sophisticated subsystems and costs will be high. The cost of the ship may prevent its being built in desired numbers, reducing presence and reducing work for the industrial base. Requirements to reduce manning can actually add sophistication if mission requirements

are not reduced. To some extent, this has happened with the DD(X) destroyer. Several years ago, it was anticipated that the ship would cost about \$1 billion, and 32 would be produced. Over time, sophistication and cost of the ship grew as mission requirements increased while manning levels lower than current destroyers were maintained. Today, each DD(X) ship will cost an average of \$3.2 billion, and no more than seven are anticipated.³ Presence (in terms of quantity) was reduced; shipyard work was reduced; and currently the program is looking at reducing some mission capacity to control cost. Similarly, the cost of the Virginia class submarine has precluded producing the volume originally anticipated. The key is to anticipate and make trade-offs early in the context of the overall shipbuilding strategy. Otherwise, the strategy will be the yield of the individual ship programs—a suboptimal outcome.

Challenges Facing the Execution of the Navy's Plan

Assuming the long-range shipbuilding plan is consistent with national military priorities, the main challenge in execution is keeping the supply and demand for funds in a rational balance that does not unduly sacrifice one objective to meet another. Except for the savings the Navy is able to generate from reductions in operation, support, and personnel costs, as well as reductions in non-ship acquisitions, the supply of funds will largely be beyond the Navy's control. The demand for funds, on the other hand, is dictated mainly by the numbers and cost of individual acquisition programs and should be a managed outcome on the part of the Navy.

Challenge 1: Securing a Sufficient Supply of Funds for Shipbuilding

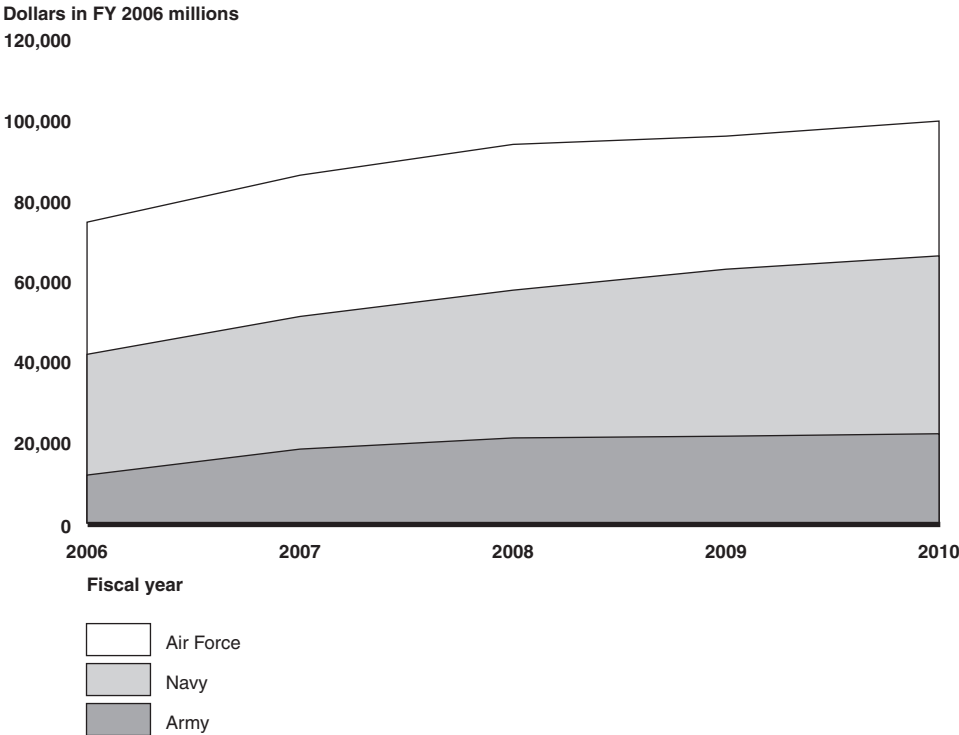
The main risk in the Navy's shipbuilding plan is that it requires more funds than may reasonably be expected. To support its plan, the Navy depends on significant increases in funding for new ship construction. The plan calls for shipbuilding funds to grow from \$8.7 billion in fiscal 2007 to \$17.2 billion in fiscal 2011 and beyond that sustains levels well above current funding. Should this funding fail to materialize, whether due to other demands on the federal budget that limit Navy funds or to overruns in other Navy programs, the shipbuilding plan will not be executable and trade-offs will have to be made.

³ According to the Navy's November 2005 Acquisition Program Baseline for the DD(X) program, program acquisition unit cost (PAUC) is \$3,154.79 million. PAUC is calculated by dividing program acquisition cost, including research and development funding, by the program acquisition quantity.

When contemplating an increase in funding that almost doubles the shipbuilding budget in the near future, it is important to keep in mind that demands on federal discretionary funds, which include the Navy's budget, are growing as well. Budget simulations show that the nation faces a large and growing structural deficit due primarily to known demographic trends and growing health care costs. In addition, current military operations, such as those in Iraq and Afghanistan, put further pressure on DOD's weapon system investments by accelerating the need for replacement or refurbishment of existing weapons.

Within this context, the development and production of new weapon systems remains one of the largest discretionary investments the federal government makes. From 2001 to 2006, DOD has doubled its planned investments in ongoing major weapons from \$700 billion to \$1.4 trillion. As shown in figure 1, DOD is planning to increase its procurement budget from about \$75 billion to about \$100 billion (33 percent) over the next 5 years to accommodate these growing investments.

Figure 2: Total Obligation Authority for Procurement (Dollars in Fiscal Year 2006 Millions)



Source: OSD (data); GAO (presentation).






According to the shipbuilding plan, the Navy will have to find substantial new funds at a time when the Army is planning to get increased funds for its Future Combat System and the Air Force plans to purchase F-22A Raptors and Joint Strike Fighters. Given the increased funding needed to cover the systems already underway and the competition for funds beyond the acquisition of systems, it will be very difficult for the Navy to secure the kinds of increases it needs to afford the long-range shipbuilding program.

Challenge 2: Controlling the Demand for Funds in Individual Shipbuilding Programs

Cost growth has been a long-standing problem for all types of weapon systems. For an individual program, cost growth represents additional and unanticipated demand for more funds. If more funds are not available, quantities to the warfighter are reduced and buying power is sacrificed. Shipbuilding programs, like other systems, have experienced cost growth. Cost growth has been particularly high on first-of-class ships. In the last 10 years, only a few first-of-class ships have been built. However, based on the long-range plan, the number of first-of-class ships will more than double in the next 10 years. If the Navy cannot control cost growth on these new ships, some other objectives of the plan would have to be sacrificed, such as mission capability or presence.

Recent shipbuilding outcomes suggest that cost growth continues to be a problem for the Navy, particularly on the lead ship(s) of a new class. (See table 1.)

Table 1: Cost Growth in Lead Ships (Dollars in Millions)

Navy lead ship		Initial and most recent President's budget request		Difference in budgets	
		Initial ^a	President's budget request ^b	Total difference	Cost growth as a percent of initial budget
LCS 1		\$212	\$274	\$62	29%
LPD 17		\$954	\$1,758	\$804	84%
SSN 774		\$3,260	\$3,752	\$492	15%
SSN 775 ^c		\$2,192	\$2,715	\$523	24%
T-AKE 1		\$489	\$538	\$49	10%
Totals		\$6,895	\$8,763	\$1,868	27%

Source: Navy (data); GAO (presentation).

^aEstimated cost from the President's budget submission for year of ship authorization.

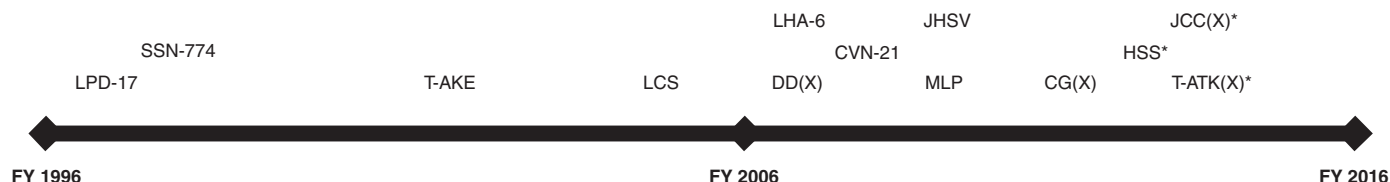
^bIncludes all prior year requests through fiscal year 2007.

^cSSN 775 is the second Virginia class submarine, but will be the first hull delivered by Northrop Grumman Newport News shipyard.

For example, the first-in-class USS San Antonio (LPD 17), commissioned in January 2006, experienced cost growth of \$804 million above its initial budget—an increase of 84 percent. The budgets for the new attack submarines, USS Virginia (SSN 774) and Texas (SSN 775), have grown by \$492 million and \$523 million, respectively, requiring Congress to appropriate additional funds to cover these increases. It is not only the first ship in the class that is at risk for cost growth; the second ship, if it is assembled in a different shipyard, is at risk as well. This was the case with the SSN 775. Devoting resources to support completion of prior year shipbuilding programs reduces the buying power of the Navy's budget for construction and can slow the pace of modernization. The Navy is in its early stages of procuring a number of advanced, new ship classes, including the DD(X) destroyer, CVN 21 aircraft carrier, and the Littoral Combat Ship. Their actual costs have yet to be realized.

The Navy's long-term shipbuilding plan envisions procuring several new classes of ships to meet force structure needs. In fact, the Navy plans to more than double its new class construction programs over the next 10 years. (See fig. 3.)

Figure 3: Schedule for Construction of New Lead Ships



Source: U.S. Navy (data); GAO (analysis and presentation).

*Dates beyond fiscal year 2011 are notional.

The financial strain of starting so many new ship programs may be unprecedented in post-World War II times. Successful development, design, and construction of these new classes will be predicated on the Navy's ability to break past patterns of cost growth. Otherwise, the Navy could be forced to divert funding from planned ship classes to cover cost overruns on its current programs. If the Navy starts more programs than it can finish within available resources, it may be forced to make trade-offs in the future that it would not find acceptable today.

Better Management of Acquisitions Can Help Reduce Unanticipated Demands for More Funds

There are several steps the Navy can take to help control unanticipated cost growth on individual programs. Primarily, these steps involve having sufficiently high levels of knowledge before making programmatic, budgetary, or contractual commitments. These measures include

- attaining requirements stability, technology maturity, and design stability early in programs;
- gaining actual experience with design before budgeting and contracting for construction;
- contracting the construction of the lead ship separately from the construction of follow-on ships; and
- employing good cost-estimating techniques and making better use of cost reports.

Implementing a Knowledge-Based Acquisition Process Can Reduce the Risk of Cost Growth in Shipbuilding Programs

A first step in stemming unanticipated cost growth is for the Navy to follow a knowledge-based acquisition approach for its new shipbuilding programs. Over the last several years, we have undertaken a body of work that examines weapon acquisitions by drawing upon lessons learned from best product development practices in both the private sector and DOD. Collectively, best practices comprise a process that ensures a high level of knowledge at key program decision points. Central to successful outcomes is the separation of technology development and product development. The process of developing technology is one of discovery and must allow room for unexpected failures that could result in delays. The process of developing a product culminates in delivery and depends on specific knowledge about a new product to stabilize design and plan for production. Similarly, it is important to stabilize design before production to avoid rework and resequencing of work, which ultimately results in cost growth and schedule delays.

Matching Customer Needs and Developer Resources Early Is Key to a Knowledge-Based Approach

We have found that it is essential that at program start, a match must be made between the customer's requirements and the product developer's available resources in terms of knowledge, time, money, and capacity. One fundamental is a balanced set of requirements that takes into account not only a desire for sizeable gains in performance, but also the resources—technology, time, and money—that are available to execute the program. One of the most important practices in reaching a match between resources and requirements is achieving a high level of technology maturity at the start of system development. This improves the ability to establish realistic cost, schedule, and performance objectives as well as the ability to meet them. We believe that in shipbuilding, technology maturity should be reached by the preliminary design review. This assures that the form, fit, and function of the individual components of a vessel are understood before they become integrated in a system design. Including immature technologies in the system design increases the risk of discovering problems late and can increase the cost and time needed to complete design and fabrication.

The match between resources and requirements can be achieved in several ways. The Littoral Combat Ship provides one way. Rather than attempting to achieve full capability in a single leap, the program is structured to deliver incremental capabilities to the warfighter through evolutionary acquisition. Evolutionary acquisition has the potential to reduce cycle times and costs by enabling developers to rely more on available resources rather than making promises about unproven technologies. The CVN-21 carrier program provides a different way to get the match. One critical technology that the Navy wants to incorporate on the new carrier is the

electromagnetic aircraft launching system. Since this system affects the design of the ship, the Navy is spending a lot of time and money to demonstrate this key technology before committing to the ship's design. The DD(X) program is somewhere in between. It has a rational approach to maturing 12 critical technologies through demonstration models, but these were not complete before the detail design phase began, and thus the DD(X) program carry technical risk into that phase.

Early Stabilization of Design Can Reduce Expensive Rework and Resequencing of Work

Another key knowledge-based practice is achieving a stable product design at the system-level design readiness review. According to Navy and contractor officials, design stability in shipbuilding is achieved through completion of general arrangement drawings, ship specifications, and major equipment lists. Attaining design stability on time can help assure that a product will meet customer requirements as well as cost and schedule targets. Programs that have entered construction before achieving stable system designs did experience significant cost growth. The lack of design maturity in these programs led to rework and resequencing of work, increasing the number of labor hours needed for ship construction. For example, in the LPD 17 program, ship design continued to evolve even as construction proceeded. Without a stable design, outfitting work for individual ship sections was often delayed from early in the building cycle to later, when these sections were integrated on the hull. Shipbuilders stated that doing the work at this stage could cost up to five times the original cost. On LPD 17, 1.3 million labor hours were deferred from the build phase to the integration phase. Consequently, LPD 17 took much longer to construct and cost more than originally estimated.

Individual Ship Strategies Align Knowledge and Decision Points Differently

While shipbuilding programs may differ in the specific knowledge that must be gained to reduce risk, the order and timing in which such knowledge must be achieved should not vary. Technology maturity must be proven before a design can be considered stable, and production outcomes cannot be guaranteed until a stable design is demonstrated. Similarly, this knowledge should correspond with and inform key decisions in a program. For example, in programs other than shipbuilding, the Milestone B decision represents the commitment to design and develop a system for production, at which time requirements should be firm and critical technologies mature.

However, each shipbuilding program seems to embody its own strategy for making decisions that vary from program to program. Milestone B means different things in different shipbuilding programs. In the DD(X) program, negotiation of a construction contract was authorized at Milestone B,

which was held shortly after the critical design review. The CVN-21 program plans to gain approval to negotiate construction of the first ship at a major program review held over 2 years after Milestone B decision. In yet another approach, the Littoral Combat Ship began construction of its first vessels about 2 years before its scheduled Milestone B decision. This inconsistency in both decision points and knowledge gained makes it difficult to gauge whether an individual program is attaining sufficient levels of knowledge at the right points in time.

Practices for Estimating Costs, Budgeting, and Contracting Can Make Funding Demands More Realistic

The Navy can take steps to more realistically provide the funds needed to execute individual programs. These include some methodological practices for cost estimates and better alignment of budgeting and contracting commitments with requisite levels of knowledge. The Navy has begun implementing some of these practices, but more can be done.

Cost Estimating and Reporting

In our analysis of shipbuilding programs last year, we found that the Navy tended to underestimate the costs needed to construct ships—which resulted in large cost increases after ship construction began. One way to improve the quality of cost estimates and reduce the magnitude of unbudgeted cost growth is to present a confidence level for a cost estimate based on risk and uncertainty analyses. By conducting uncertainty analyses that measure the probability of cost growth, the Navy can identify a level of confidence for its cost estimates. The Navy can then make better-informed budget decisions on whether to proceed with a program. The Navy has begun taking some action to improve its cost estimating capabilities, including the use of quantitative risk analysis in generating shipbuilding cost estimates. For example, the Navy did conduct an uncertainty analysis for the DD(X) cost estimate. The analysis showed the current estimate to have a confidence level of 45 percent, meaning that the program has a 45 percent chance of achieving its estimated cost. This represents a positive step in creating more transparent cost estimates. We believe that the Navy and DOD should go on to establish an acceptably high confidence level on which to base more realistic program commitments and budget requests. Recently, the Defense Acquisition Performance Assessment panel recommended that an 80 percent confidence level is necessary to ensure realism in a budget request.

The Navy can also use contractor cost performance reports more effectively. With the significant risk of cost growth in shipbuilding programs, it is important that the Navy receive timely and complete cost

performance reports to allow it to take corrective actions more quickly. DOD recently issued changes to its earned value management policy requiring contract performance reports to be submitted no less than monthly. Monthly cost performance reports can help improve the Navy's ability to mitigate risk on ships currently under construction. Although the Navy will implement this policy on future contracts, it stated that it will not apply monthly reporting requirements retroactively. As a result, current programs such as the Virginia class submarine, which continues to experience high cost growth, will only receive cost performance reports on a quarterly basis—slowing the Navy's ability to take corrective action against negative cost and performance trends.

Budgeting and Contracting

The Navy can better ensure realism in its budgets and contracts by separating requests for funding detail design from construction. Generally, the Navy has requested authorization for both detail design and construction of the lead ship in a single budget year, before research and development have been completed and an independent cost estimate developed. Contract prices are often negotiated for constructing the lead ship and early follow-on ships before detail design has even begun. In our February 2005 report, we recommended that the Navy allow time to gain knowledge from detail design before negotiating contract prices for the construction of the lead ship and time to gain knowledge from the lead ship before negotiating contracts for follow-on ships. This would enable knowledge and experience to be gained with the design before locking in budget requests and contractual commitments.

Budget requests for DD(X) illustrate the problems with requesting funding early, when uncertainty about costs is high. The Navy first requested funding for detail design and construction of the lead ship in February 2004 as part of its fiscal year 2005 budget request. According to the Navy's budget presentation, detail design and construction would cost \$2.7 billion. The Congress did not fund construction of the lead ship but instead provided funding for detail design and some materials in the fiscal years 2005 and 2006 budgets. In March 2005, the Navy completed a detailed life-cycle cost estimate for DD(X) that placed the cost of DD(X) at \$3.3 billion. The independent cost estimate placed the cost even higher. The budget request for fiscal year 2007 now includes \$3.3 billion for each of the two lead ships. Though the accuracy of this estimate is still being debated, it is clearly more realistic than the budget estimates of 2 years ago.

The same logic applies to contracting for follow-on ships. Early negotiation of follow-on ship contracts can also affect the realism of program cost estimates and budget requests to fund these contracts.

Experience has shown the difficulty in delivering the lead ship of a class within estimates. Negotiating contracts for follow-on ships at the same time as the lead ship extends the estimating weaknesses to those ships as well. The result is unbudgeted demands for increased funds. While the Navy maintains that this practice can give the government some leverage in negotiating prices, a possible advantage only exists in the case of ships acquired under fixed-price contracts—a rare occurrence for new ship classes.

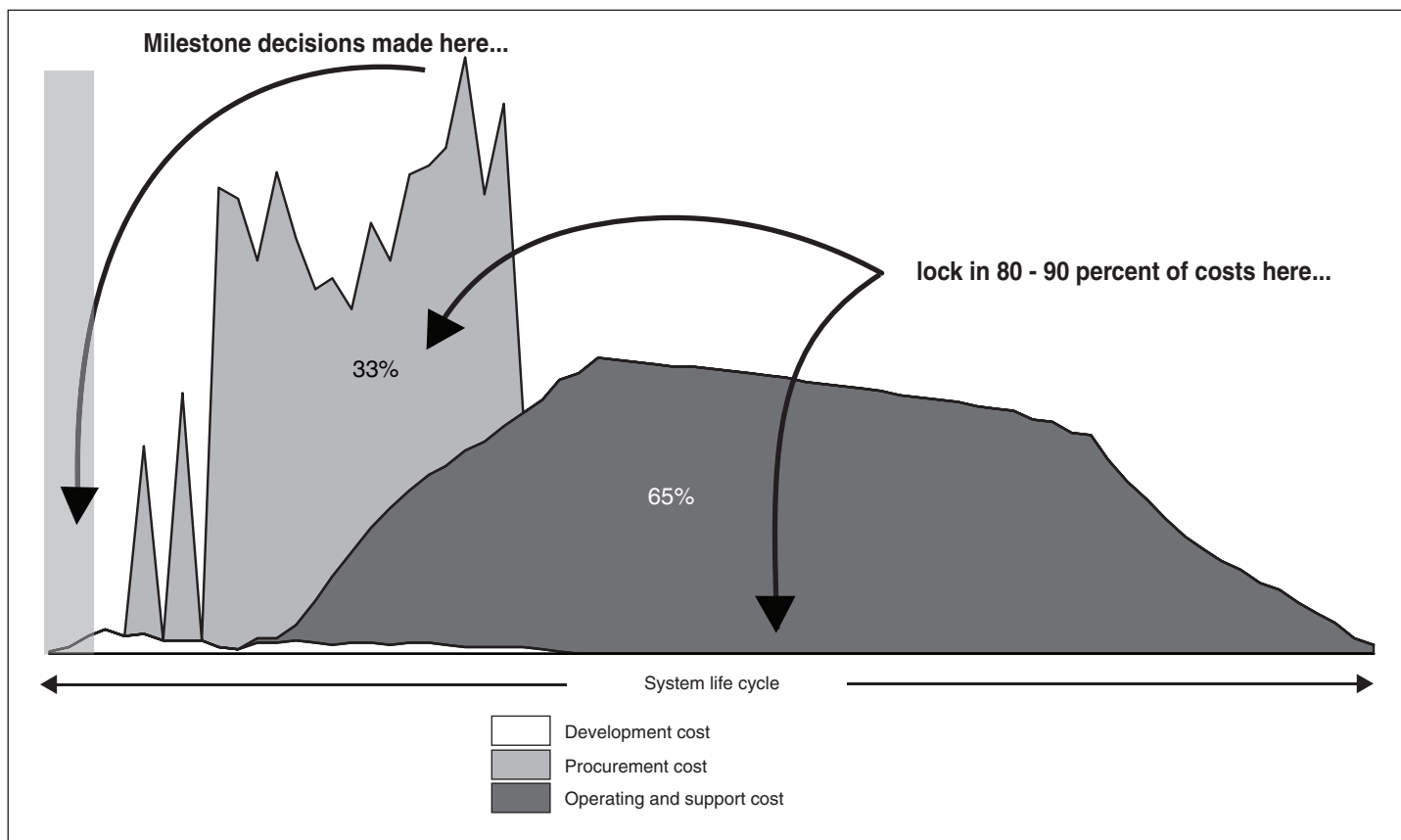
Savings in Long-Term Operations and Maintenance Costs are Needed to Free Funds for Shipbuilding

The Navy's efforts to control personnel costs and minimize total ownership costs have been important in their own right. Today, these efforts are becoming increasingly important because the savings they produce are one source of the increased funding sought for the Navy's long-range shipbuilding plan.

Optimizing Ship Crew Size Can Reduce Total Ownership Costs

The ship's crew is the single largest cost incurred over the ship's life cycle. One way to lower personnel costs is to use a systems-engineering approach called human systems integration to optimize crew size. This is particularly important in the early phases of a ship program as total ownership costs are largely determined during a ship's design. (See fig. 4.)

Figure 4: Total Ownership Costs Are Determined Early in a System's Development



Source: U.S. Navy.

Applying human systems integration principles to optimize crew size has the potential to yield substantial cost and operational benefits, including saving billions of dollars by reducing total ownership costs and increasing operational performance and ship maintainability.

We have reported that the Navy has not consistently optimized ship crew size.⁴ For example, we calculated that a nominal 25 percent reduction in a large deck amphibious ship such as the LHA(R) with a 1,245-person crew could provide a personnel cost avoidance of nearly \$1 billion over the

⁴ See GAO, *Military Personnel: Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs*, [GAO-03-520](#) (Washington, D.C.: June 9, 2003).

service life of a ship.⁵ However, the LHA(R) program did not establish a crew reduction requirement. As a result it is unlikely to achieve a meaningful reduction in crew size. The DD(X) destroyer program is an example of how requiring human systems integration early, establishing a crew size reduction requirement as part of the design, and holding program managers accountable can create significant progress toward reducing crew size. While actual reductions remain to be seen, currently, the crew size for the DD(X) is estimated at 150, compared with 382 for the current DDG 51 class destroyer.

Increasing Operational Availability

The Navy has developed and implemented several initiatives to increase the operational availability of Navy and Marine Corps fleet forces, including the Fleet Response Plan and rotational crewing. Navy officials have cited these initiatives as ways to increase readiness and reduce the numbers of ships needed in the Navy's force structure, thereby freeing funding for other priorities. The Fleet Response Plan modifies the Navy's pre-2001 rotational deployment policy, replacing 6-month routine deployments with more flexible deployment options for as many as eight carrier strike groups when and where needed. The Navy has also demonstrated that rotating crews aboard surface ships on extended deployments may be a feasible alternative to traditional 6-month ship deployments. According to the *2006 Quadrennial Defense Review Report*, the Fleet Response Plan has increased the amount of time a ship or other naval unit is fully ready to deploy, and rotational crewing has further increased the operational availability of forces by up to 33 percent.

These are positive results for which the Navy deserves credit. As the Navy extends these initiatives to more ships, we have recommended steps it can take to get maximum return on investment and offset billions of dollars in future total ownership costs. These include establishing an analytical framework—consisting of formal measurable goals, objectives, and metrics—that could be used to assess the feasibility of operational availability initiatives and determine their impact on operational requirements, ship condition, and crew morale.⁶ In the past, the Navy had

⁵ Fiscal year 2002 dollars.

⁶ See GAO, *Force Structure: Navy Needs to Fully Evaluate Options and Provide Standard Guidance for Implementing Surface Ship Rotational Crewing*, [GAO-05-10](#) (Washington, D.C.: Nov. 10, 2004); GAO, *Military Readiness: Navy's Fleet Response Plan Would Benefit from a Comprehensive Management Approach and Rigorous Testing*, [GAO-06-84](#) (Washington, D.C.: Nov. 22, 2005).

not systematically collected or developed accurate cost data to perform complete cost-effectiveness analysis. We believe that the Navy needs to more systematically collect data on current and potential operational availability initiatives, including complete and accurate cost data for cost-effectiveness analyses. This will facilitate informed decisions about the potential for applying these initiatives to current and future ships.

Mr. Chairman this concludes my statement and I would be pleased to answer any questions.

Objectives, Scope, and Methodology

To develop information on obstacles for the Navy's long-term shipbuilding strategy and practices for improving the acquisition of programs that make up that strategy, we relied largely on work previously performed for a number of related GAO products as well as the Navy's planning documents and testimony. In the course of our previous work we analyzed the documentation of and interviewed officials associated with a number of shipbuilding programs including CVN-21, DD(X), and the Littoral Combat Ship. In our past work on analyzing cost growth in shipbuilding, we reviewed cost performance and earned value data on a number of ships then in construction, as well as applicable Navy acquisition guidance. In addition, we interviewed officials with the Navy and Office of Secretary of Defense with oversight of cost estimating and contract execution. To supplement work previously performed we analyzed the Navy's most recent long-term plan for shipbuilding and updated some figures on cost estimates through use of the Navy's budget justification documentation.

Contact and Staff Acknowledgments

For future questions about this statement, please contact me at (202) 512-4841. Individuals making key contributions to this statement include Robert L. Ackley, Christina Connelly, Ryan Consaul, Diana Dinkelacker, Christopher R. Durbin, J. Kristopher Keener, Patricia W. Lentini, Roderick W. Rodgers, Janet St. Laurent, Martin G. Campbell, and Karen Zuckerstein.

Related GAO Products

Military Readiness: Navy's Fleet Response Plan Would Benefit from a Comprehensive Management Approach and Rigorous Testing.

[GAO-06-84](#), Washington, D.C.: Nov. 22, 2005.

Defense Acquisitions: Progress and Challenges Facing the DD(X) Surface Combatant Program. [GAO-05-924T](#), Washington, D.C.: July 19, 2005.

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